COTTAGE POLLUTION CONTROL PROGRAM

KAGAWONG LAKE

MANITOULIN ISLAND

1980

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COTTAGE POLLUTION CONTROL PROGRAM

KAGAWONG LAKE

MANITOULIN ISLAND

1980

Prepared by:

Ministry of the Environment,
Northeastern Region,
Sudbury District,
Pollution Abatement Section.

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TABLE OF CONTENTS

SUMMARY

During the summers of 1979 and 1980, the Abatement Section of the Ministry of the Environment completed a "Cottage Pollution Control Survey" on Lake Kagawong, (including the Townships of Allan, Campbell and Billings), Manitoulin Island, at the request of the Manitoulin Planning Board.

During the survey, 200 cottages, homes and tourist lodges were visited and a lot inspection and questionnaire completed at each site. A bacteriological survey of the lake water was also undertaken.

The majority of the cottage owners were found to utilize pit privies in combination with leaching pits for the disposal of sewage wastes.

The investigation found 123(61.5%) establishments with sewage systems operating satisfactorily. Problems associated with wash water (grey water)and toilet wastes were observed at 46(23%) of the establishments. Three (1.5%) of the sewage disposal systems were substandard, and 7(3.5%) were direct pollutors and 21(10.5%) systems were unclassified, see Appendix H.

Drinking water quality was found to be good at the communal supplies and at establishments with wells who asked to have a sample taken.

The lake water quality was found to be within the limits for recreational water quality.

INTRODUCTION

At the request of the Manitoulin Planning Board, the Abatement Section of the Ministry of the Environment conducted a "Cottage Pollution Control Survey" on Lake Kagawong. The purpose of the survey was to collect information on the sewage disposal systems serving the cottages on the shoreline of the lake, to indicate the degree of development present, and to determine the impact of present development on the water quality of Lake Kagawong.

LOCATION

Lake Kagawong is located on Manitoulin Island, in the Townships of Campbell, Allan, and Billings, in the District of Manitoulin. The location of the lake is shown in Appendix A.

The Lake is located approximately 48 km west of Little Current. It is the second largest lake on Manitoulin Island and occupies an area of about 5600 Ha. For a detailed physical description, see Appendix B.

DEVELOPMENT

At the time of the survey there were 200 establishments situated along the shoreline of the lake. The length of the shoreline is approximately 61 km. Development consists of 170(85%) cottages, 10(5%) homes, 5(2.5%) campgrounds, 13(6.5%) tourist lodges, and 2(1.0%) trailers. The majority, 175 (87.5%), of these properties are used in the summer months only. Appendix C, Tables I and II summarizes establishment type and use.

The two areas with the largest concentration of development are Kagawong Bay, and the area around the Hamlet of Perivale. Appendix D indicates the areas of development.

In the past, 15,000 square feet has been considered the minimum area on which a septic tank system and a well could be located and comply with the distance requirements as set down in Ontario Regulation 229/74 of the Environmental Protection Act, 1971. It was found that the majority, 60(30%), of the determinable lot sizes were greater than 15,000 square feet, and in compliance with the Regulation. It was felt that the majority of the 112(56%) unknown lot sizes were also in this catagory.

Appendix C, Table III summarizes the lot sizes of the establishments surveyed.

PHYSIOGRAPHY AND TOPOGRAPHY

The area surrounding Lake Kagawong is typical of Manitoulin Island containing shallow mineral soil and limestone outcrops. The watershed is comprised of 40% flat, 40% rolling, 15% hilly, and 5% mountainous lands. The areas of maximum development are predominantly flat.

The dominant tree species in the area are White Birch, Cedar, Elm, and Silver Maple.

SURVEY PROCEDURES

Due to the large number of cottages, the survey was phased over a two year period. Field work took place between July 23 - August 8 in the summer of 1979, and on June 29 and June 30 in 1980. Information was collected from each of the 200 establishments situated along the shoreline of the lake.

At each establishment, a survey number was assigned and a detailed description of the establishment was recorded for ease of future identification. A survey questionnaire (Appendix E and F) was then completed with the aid of the owner, if available, or from a cursory examination and any help that could be obtained from neighbours. The owners name, address, type of sewage disposal system and its adequacy, type of water supply, and treatment were recorded. In addition, a sketch of the lot, showing the locations of all buildings, water supplies, sewage disposal systems and roads and their relation to the lake was prepared. Upon completion of the inspection of each location a classification was determined and recorded (see Appendix G and H). If any problems were found with regards to sewage disposal, a "Pollution Abatement Report" form was completed and a copy left at the site.

Upon completion of the survey, copies of the Pollution Abatement reports were forwarded to the Sudbury and District Health Unit for follow-up action. If the owner was not present and no problems were found, a letter was left indicating the establishment had been inspected.

Water samples were collected for chemical and bacteriological analysis from each of the two communal sources of drinking water. In addition, samples were taken where requested by property owners on wells. Bacteriological samples were forwarded to the Ministry of Health Laboratory in Sudbury to be analysed for total and fecal coliform organisms. The chemical samples were analysed at the Ministry of the Environment Laboratory in Toronto for sodium, hardness, alkalinity, iron, chloride, pH, color, turbidity, conductivity, and nitrate.

No drinking water samples were collected at establishments using the lake as their water supply.

LOT SURVEY AND QUESTIONNAIRE RESULTS

Sewage Disposal

Each establishment was classified as to its acceptability using the classfications found in Appendix G.

The survey of the 200 establishments indicated that the majority 123(61.5%) of the sewage disposal systems were operating satisfactorily at the time of the inspection.

Three (1.5%) of the establishments were found to have seriously substandard disposal systems. These systems were incapable of handling the amount of sewage or the type of sewage discharged to them. These systems require upgrading or replacement.

The largest number of problems 46(23%) were found to be nuisance problems. Of these, 30(15%) were classified as nuisance wash water. This problem relates to wash water being discharged directly onto the ground surface, or the present system being inadequate in size, permitting the discharged material to seep out onto the ground surface. The remaining 16(8%) problems were classified as a nuisance with respect to potential for contamination of water supplies by toilet waste. The majority of these were pit privies either of poor construction, or located too close to the lake or a drinking water source. These systems require upgrading and in some cases, the installation of a proper leaching pit for the disposal of wash water.

There were found to be 7(3.5%) direct pollutors. These establishments were discharging effluent, either directly or indirectly through rocks crevices leading to the lake. These systems are illegal and have been reported to the Sudbury and District Health Unit for follow-up action.

The status of the sewage disposal systems at the 200 establishments surveyed are summarized in Appendix H. These 200 establishments were found to have 435 sewage disposal systems. The types of disposal systems utilized are summarized in Appendix I, Table I.

The majority of the sewage disposal systems were pit privies 133(30.5%), and leaching pits 101(23.25%). Most of these systems were used in combination utilizing pit privies for toilet waste, and leaching pits for wash water.

Of the remaining systems inspected, there were 31(7.12%) holding tanks, 75(17.24%) septic tank and tile fields, 27(6.2%) had just the septic tanks with no tile bed, 22(5.05%) cesspools, 2(0.50%) chemical toilets, 1(0.25%) direct discharge to the lake, and 19(4.36%) which could not be determined.

The majority, 352(85.64%) of the sewage disposal systems are located a distance greater than 50 feet from the lake. The remaining 40(9.74%) were found to be less than 50 feet from the lake, while 19(4.62%) distances would not be determined. Appendix I, Table II summarizes the distance sewage disposal systems are from the lake.

Water Supplies

Appendix J, Tables I and II summarizes the drinking water sources and type of treatment used as reported by the owners.

Of the 200 establishments, 48(24%) were on wells, 109(55%) were served by the lake, 2(1%) by springs, 21(10%) hauled water, and 20(10%) could not be determined.

Treatment provided by residents on these water supplies consisted of 16(8%) which boiled, 16(8%) which filtered, 10(5%) which chlorinated, and 3(2%) which used other means such as ultra violet disinfection on their water supply. Type of treatment could not be determined for fifty (25%) of the supplies. One hundred and five (52%) did not utilize any type of treatment.

Of the water supply sytem samples collected, all were found to be within Ministry objectives both chemically and bacteriologically.

The Ministry of the Environment recommends that all residences using surface water as a drinking source have their water disinfected (such as by chlorination), as any surface water may have harmful bacteria present at any time.

LAKE SAMPLING

A program to assess lake water quality took place during the survey. One hundred sample locations were situated around the lake, approximately 3 metres from shore concentrated in front of areas of heavy development. Appendix K, shows the location of sampling points. Samples were forwarded to the Ministry of Health to be analyzed for total and fecal coliform organisms.

The results of analysis were then tabulated and the geometric mean calculated for each sample point. These results are shown in Appendix L. Appendix M shows the relative frequency of occurrence of total coliform organisms while Appendix N shows the relative frequency of occurrence of fecal coliform organisms. Histograms were created using the geometric mean values of each sample point. These indicate that the majority of sample points had total coliform organism levels between 0 and 14/100 ml, and fecal coliform organisms between 0 and 4/100 ml.

The Ministry of Health criteria for recreational water quality states that a potential health hazard exists if the fecal coliform geometric mean density for a series of water samples exceeds 100 per 100 ml, while for total coliform the sample should not exceed 1000 per 100 ml. All sample points were found to be well within these guidelines.

The Ministry of the Environment has conducted a routine spring phosphorus program since 1977 on Lake Kagawong. The program consists of sampling six (6) locations on the Lake for phosphorous, routine chemical parameters and Secchi disc measurements. The 1979 sample results indicate an average phosphorous level of 8.2 mg/m^3 (Level 1) and an average Secchi depth of 5.2 meters.

The water quality of Lake Kagawong for recreational purposes is within the acceptable guidelines and the Ministry will continue to monitor the spring phosphorous of the Lake.

CONCLUSIONS

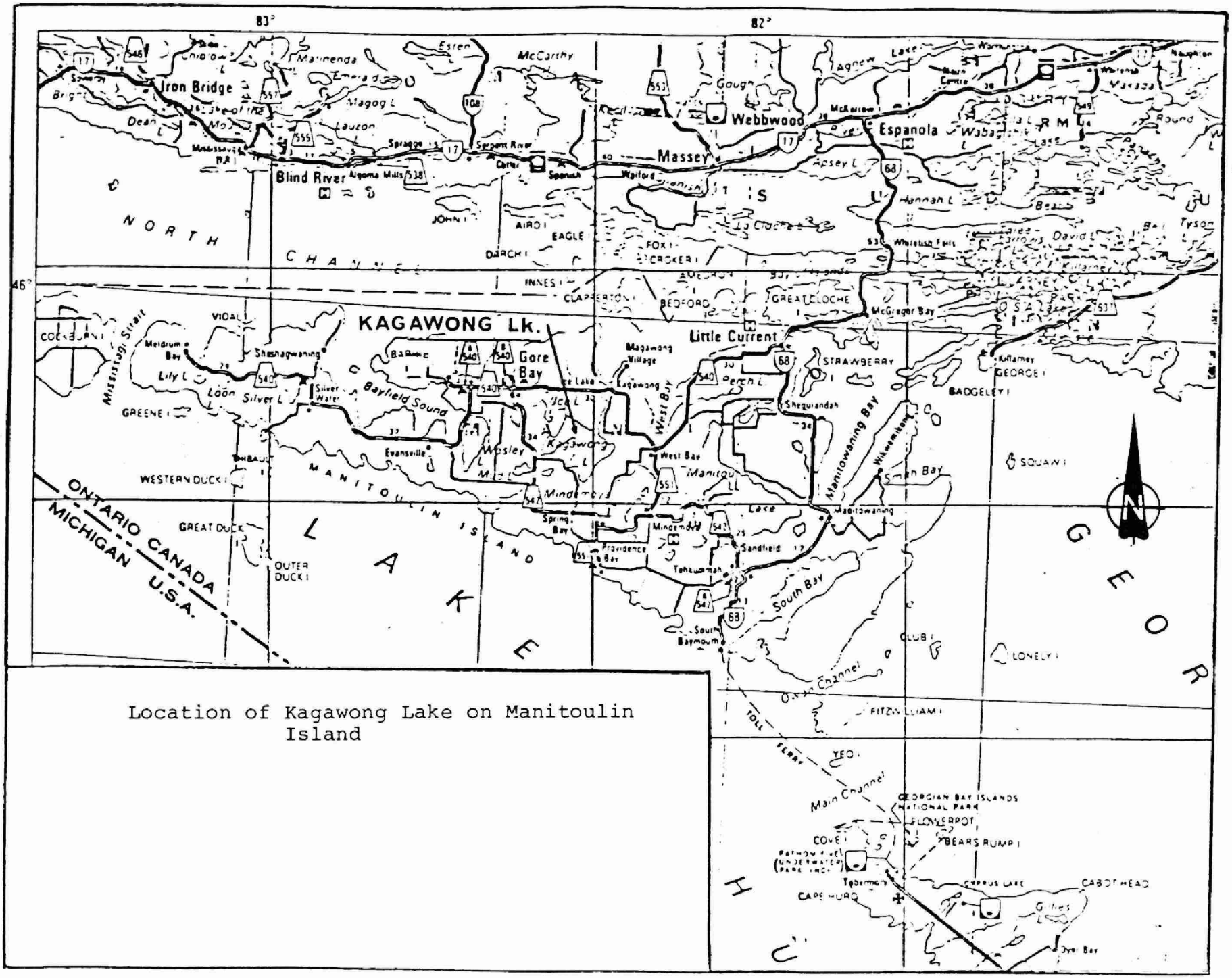
As a result of this survey the following conclusions may be drawn:

1. The majority of the sewage disposal systems were found to be adequate. Systems found to be inadequate were mainly nuisances and can be corrected with little effort. A list of these establishments has been forwarded to the Sudbury and District Health Unit for follow-up action.

2. Drinking water quality was assessed to be adequate. However people using the lake as a source of potable water may improve their water quality by the installation of some form of treatment (i.e. chlorination).

3. The lake water quality was found to be well within the acceptable guidelines for recreation use.

4. The Ministry of the Environment will continue its spring phosphorus sampling program on the lake.



Location of Kagawong Lake on Manitoulin Island

APPENDIX B

PHYSICAL CHARACTERISTICS

LAKE KAGAWONG

MANITOULIN ISLAND

Latitude	45^{o} 49'
Longitude	82^{o} 18'
Elevation (ft)	700
Kilometers of Shoreline	61
Surface Area (Ha)	5557.89
Mean Depth (m)	11.22
Maximum Depth (m)	33.53
Volume (m^3)	6.2324×10^3

Sports Fishery: Northern Pike, Smallmouth Bass, Yellow Perch

Watershed:
40% Flat
40% Rolling
15% Hilly
5% Mountainous

Sources of Water: Bottom springs

Aquatic Vegetation: Sparse emergent, submergent and floating

Outflow: 3 outlets - undetermined flow

Dominant Tree Species:
White Birch
Eastern Cedar
Elm
Silver Maple

Soil Conditions:
55% Detritus
30% Sand
10% Gravel
5% Bedrock

APPENDIX C

TABLE 1

ESTABLISHMENT TYPES

	NUMBER	% OF TOTAL
Cottage	170	85
Home	10	5
Campground	5	2.5
Cottage Establishment	13	6.5
Trailer	1	0.5
Other	1	0.5

TABLE II

ESTABLISHMENT USE

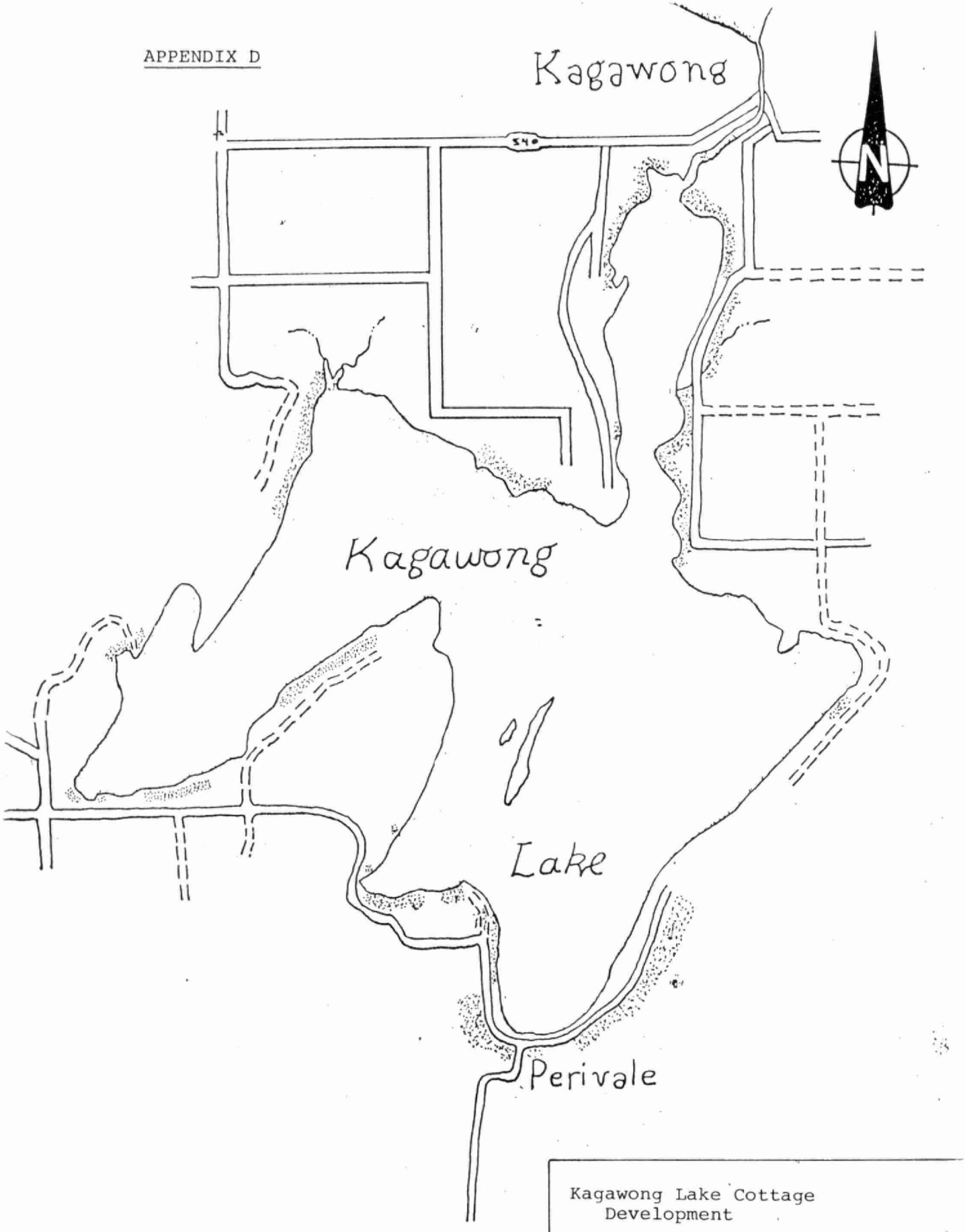
	NUMBER	% OF TOTAL
Summer	175	87.5
Year Round	11	5.5
Summer/Occasional Winter	6	3
Not in Use	1	0.5
Under Construction	3	1.5
Unknown	4	2

TABLE III

LOT SIZES

AREA (Sq. Ft.)	NUMBER	% OF TOTAL
< 2500	1	0.5
2501 - 5000	0	0.0
5001 - 10000	7	3.5
10001 - 15000	20	10
< 15000	60	30
Unknown	112	56

APPENDIX D


Kagawong
540
N
Kagawong
Lake
Perivale
Kagawong Lake Cottage Development
Areas with Development

Ministry of the Environment

Ontario

COTTAGE POLLUTION CONTROL PROGRAM

ESTABLISHMENT IDENTITY

LAKE OR RIVER No (1–6) | ESTABLISHMENT SURVEY No (7–11) | SUB EST No (12–13) | TRANS CODE (14–15)

ESTABLISHMENT DESCRIPTION

CARD No 01 (16–17) | HYDRO METER No (18) | DATE OF INSPECTION DAY MONTH YEAR (26) | LOT SIZE (32) | UNIT OF LOT SIZE SQ FT / ACRES (40–41) | USE (42) | No OF OCCUPANTS AVERAGE (43) / MAXIMUM (47) | No BEDROOMS (51) | ESTABLISHMENT TYPE (53)

ACCESSIBLE BY ROAD Yes (55) No (56)

NAME OF ROAD _____

USE
1 SUMMER ONLY
2 YEAR ROUND
3 SUMMER OCCASIONAL WINTER
4 PREDOMINANT WINTER
5 NOT IN USE—CLOSED
6 UNDER CONSTRUCTION

TYPE OF ESTABLISHMENT
01 PRIVATE COTTAGE
02 CABIN ESTABLISHMENT
03 COTTAGE ESTABLISHMENT
04 CAMP
05 PICNIC AREA/PUBLIC PARK
06 MARINA
07 HOTEL/MOTEL
08 RESTAURANT
09 STORE
10 FARMHOUSE
11 CLUB
12 INDUSTRIAL
13 BOATHOUSE
14 PERMANENT HOME
15 CAMPGROUND/TRAILER PARK
16 OTHER

ESTABLISHMENT OWNER

TITLE (57) | INITIALS (61) | SURNAME (64–80)

TELEPHONE No _____

IF PERSON INTERVIEWED IS NOT OWNER NAME _____

MAILING ADDRESS

CARD No 02 (16–17)

OWNER'S PERMANENT MAILING ADDRESS (18 / 42 / 66)

CLASSIFICATION

PRELIMINARY (79) | FINAL (80)

1 SATISFACTORY
2 SATISFACTORY PERFORMANCE
3 SERIOUSLY SUBSTANDARD
4 NUISANCE (WASH WATER)
5 NUISANCE (TOILET, SOLID WASTE)
6 DIRECT POLLUTER
7 UNCLASSIFIED (TEMPORARILY)
8 UNCLASSIFIED

INITIALS _____

DESCRIPTION OF FACILITIES

CARD No 03 (16–17)

	FIXTURES & APPLIANCES											TOILETS									
	BATHROOM WASH BASIN	DISHPAN	BATH WITH SHOWER	BATH	STALL SHOWER	KITCHEN SINK	AUTOMATIC DISHWASHER	WASHING MACHINE (Wringer)	WASHING MACHINE (Auto.)	LAUNDRY TUB	GARBAGE GRINDER	STANDARD FLUSH	URINAL	LOW VOLUME FLUSH	PIT PRIVY	VAULT PRIVY	AQUA PRIVY (Pail a day)	INCIN TOILET—GAS	INCIN TOILET—ELECT	CHEMICAL TOILET	OTHER (Specify)
QUANTITY	18					25						30			35				40		

SLOPE OF LOT GROUND (53–56)
0-5% (Flat) | 5-10% (Moderate) | 10-20% (Mod Steep) | >20% (Steep)

DRINKING WATER

SOURCE PRIMARY (42) / OTHER (43) | SOURCE IF IMPORTED (44) | TREATMENT PRIMARY (45) / OTHER (46) | LAUNDRY DONE AT COTTAGE YES (47) / NO (48) | PIPED WATER YES (49) / NO (50) | REFUSE PRIMARY (51) / OTHER (52)

DRINKING WATER SOURCE
1 LAKE
2 COTTAGE DUG WELL
3 COTTAGE DRILLED WELL
4 CISTERN FOR RAINWATER
5 MUNICIPAL
6 OTHER (SPECIFY)

DRINKING WATER TREATMENT
1 NONE
2 BOILED OR FILTERED AND BOILED
3 FILTERED
4 DISINFECTED BY CHLORINE
5 DISINFECTED BY OTHER MEANS
6 FILTERED AND DISINFECTED BY CHLORINE
7 FILTERED AND DISINFECTED BY OTHER MEANS
8 OTHER (SPECIFY)

REFUSE
1 TO MUNICIPAL DUMP
2 TO LOCAL DUMP
3 TAKEN HOME
4 DEPOSITED IN LAKE
5 DEPOSITED ELSEWHERE
6 BURIED ON LOT
7 BURNED (INCINERATED)
8 OTHER (SPECIFY)

MOE 1079 5/76

SEPTIC TANKS

CARD No 0 4 (16 17)

TANK No (18) | CAPACITY: LIQUID (19) TOTAL (21) GALLONS | YEAR INSTALLED (25) | LAST YEAR CLEANED (27) | MATERIAL (29) | APPROVAL (30) | APPROV AGENCY (31)

MATERIAL
1 CONCRETE 4 CONC BLOCK
2 STEEL 5 OTHER (SPECIFY)
3 FIBERGLASS

APPROVAL
1 NO REFERRAL 3 NOT APPROVED
2 REFERRAL NOT YET APPROVED 4 APPROVED

APP AGENCY
1 HEALTH UNIT
2 MIN OF ENV
3 MUNICIPAL

TILE FIELDS

FIELD No (32) | TOTAL LENGTH OF TILES (FT) (33) | DISTANCE BETWEEN LINES (FT) (37) | HEIGHT ABOVE LAKE (FT) (39)

BACTERIOLOGICAL SAMPLE RESULTS

CARD No 0 5 (16 17)

TOTAL COLIFORM (18 27 36 45 54 69)

FAECAL COLIFORM (22 31 40 49 61 71)

LOC'N (D)

1 to 9 — NORMAL LAKE OR RIVER SHORE SAMPLE No
D — DRINKING WATER
S — SEWAGE SAMPLE
C — CONTROL SAMPLE

EVALUATION OF SYSTEM

CARD No 0 6 (16 17)

DISTANCE TO
1 ALL MEASUREMENTS ARE SHORTEST DISTANCES
2 MEASUREMENT FROM POINT OF WASTE DISCHARGE ON GROUND SURFACE

SYSTEM No (18) | SYSTEM TYPE (19) | LAKE OR RIVER (FEET) (21) | STREAM ON OR ABUTTING LOT (FEET) (24) | DRINKING WELL (FEET) (27) | BUILDING (FEET) (30) | PROPERTY BOUNDARY (FEET) (32)

TYPE OF WASTE (34): TOILET | BATHTUB, SHOWER, BATHROOM WASH BASIN | KITCHEN | LAUNDRY | UNKNOWN

CONSTRUCTION (39): POOR | INFERIOR MATERIALS | UNKNOWN CONSTRUCTION

OPERATION (42): SYSTEM OVERLOADED | SYSTEM ABUSED | UNKNOWN OPERATION

PERF (45): FIRST | SECOND

CLASSIFICATION

PERFORMANCE
1 POLLUTING DRINKING WELL
2 POLLUTING GROUND WATER
3 PONDING
4 EFFLUENT SURFACING
5 EFFLUENT BREAKING OUT
6 LEAKING
7 BAD ODOURS
8 NOT VERIFIED
9 OK

01 SEPTIC TANK
02 TILE FIELD
03 ON GROUND SURFACE
04 INTO LAKE RIVER
05 DEATH NO PUT
06 PIT PRIVY
07 CESSPOOL
08 HOLDING TANK
09 LAGOON
10 MUNICIPAL
11 REFUSE
12 OTHER (SPECIFY)

SOIL PROFILE

CARD No 0 7 (16 17)

SOIL TYPES
1 ORGANIC 4 SILT
2 GRAVEL 5 CLAY
3 SAND

HOLE 1 (IN TILE FIELD IF ONE EXISTS)

HOLE 2 (IN TILE FIELD IF ONE EXISTS)

	HOLE 1 SOIL STRATUM (FT)	HOLE 1 MAINLY COMPOSED (1)	HOLE 1 WITH CONSIDERABLE AMOUNT OF	HOLE 1 MINOR AMOUNT OF	HOLE 2 SOIL STRATUM (FT)	HOLE 2 MAINLY COMPOSED (1)	HOLE 2 WITH CONSIDERABLE AMOUNT OF	HOLE 2 MINOR AMOUNT OF
FIRST	18	20	21	22	42	44	45	46
NEXT	23	25	26	27	47	49	50	51
NEXT	28	30	31	32	52	54	55	56
NEXT	33	35	36	37	57	59	60	61

DEPTH TO IMPERVIOUS LAYER (38 40) OR DEPTH TO GROUND WATER (62 64)

SOIL DEPTH RANGE OVER WHOLE PROPERTY: FT (65) TO FT (69)

SOIL IS: NATURAL (70) | FILL (71) | INSUFFICIENT SOIL (72) | UNSUITABLE SOIL (73)

RECOMMENDED ACTION AND COMMENTS (BY SUPERVISOR)

CARD No 0 8 (16 17)

CARD No 0 9 (16 17)

(20 50 20 50)

ESTABLISHMENT IDENTITY

LAKE OR RIVER No | ESTABLISHMENT SURVEY No | SUB EST No | TRANS CODE (74)

APPENDIX G

SEWAGE SYSTEM CLASSIFICATION

The sewage disposal systems of all the cottages surveyed were classified into one of the foolowing categories:

Satisfactory: The systems met the provincial standards at the time of the survey, relating to materials of construction, sizing, distances from water courses, as outlined in Regulation 229 of The Environmental Protection Act and were being properly maintained.

Satisfactory Performance: No obvious signs of pollution or of system malfunction were noted at the time of inspection. The disposal system may be antiquated or may not precisely meet regulations, but no fault in operation was noted.

Seriously Substandard: Systems with serious defects in construction, materials of construction, maintenance, sizing or systems located in poor soil conditions and/or closer than the required distances to water bodies. An immediate health or environmental concern existed.

Nuisance - (Wash Water): A system allowing the disposal of sink water or laundry water onto the ground surface. As well as a potential hazard, such discharges allow the untreated release of nutrients which may encourage weed growth and affect the aesthetics of the receiving water body.

Nuisance (Toilet & Solid Waste): Systems including poorly constructed or maintained privies. Also included in this category are garbage, scrap, etc., which allow conditions suitable for the procreation of vermin.

Direct Polluter: A system permitting human waste to directly enter the groundwater or surface water through piping or runoff on the ground surface, or after inadequate treatment.

Unclassified: Systems which could not be satisfactorily classified due to insufficient informationor systems which at the time of inspection were under construction.

APPENDIX H

CLASSIFICATIONS OF ESTABLISHMENTS SURVEYED

	NUMBER	% OF TOTAL
Satisfactory	14	7.00
Satisfactory Performance*	109	54.50
Seriously Substandard	3	1.50
Nuisance Washwater	30	15.00
Nuisance Toilet	16	8.00
Direct Polluter	7	3.50
Unclassified	21	10.50

* Classification of a system as "satisfactory performance" is not necessarily a statement of endorsement or official approval of the system which, although functioning satisfactorily during the survey, may not meet current standards.

APPENDIX I

TABLE I

SEWAGE DISPOSAL

TYPE	NUMBER	% OF TOTAL
Holding Tank	31	7.12
Septic Tank & Tile Field	75	17.24
Septic Tank	27	6.20
Cess Pool	22	5.05
Leaching Pit	101	23.25
Pit Privy	133	30.50
Chemical Toilet	2	0.53
Into Lake	1	0.25
Unknown	19	4.36
No Disposal Washwater	24	5.50

TABLE II

DISTANCE SEWAGE DISPOSAL FROM LAKE

DISTANCE (ft)	NUMBER	% OF TOTAL
<25	8	1.95
26 - 50	32	7.79
51 - 100	131	31.87
<100	221	53.77
Unknown	19	4.62

APPENDIX J

TABLE I

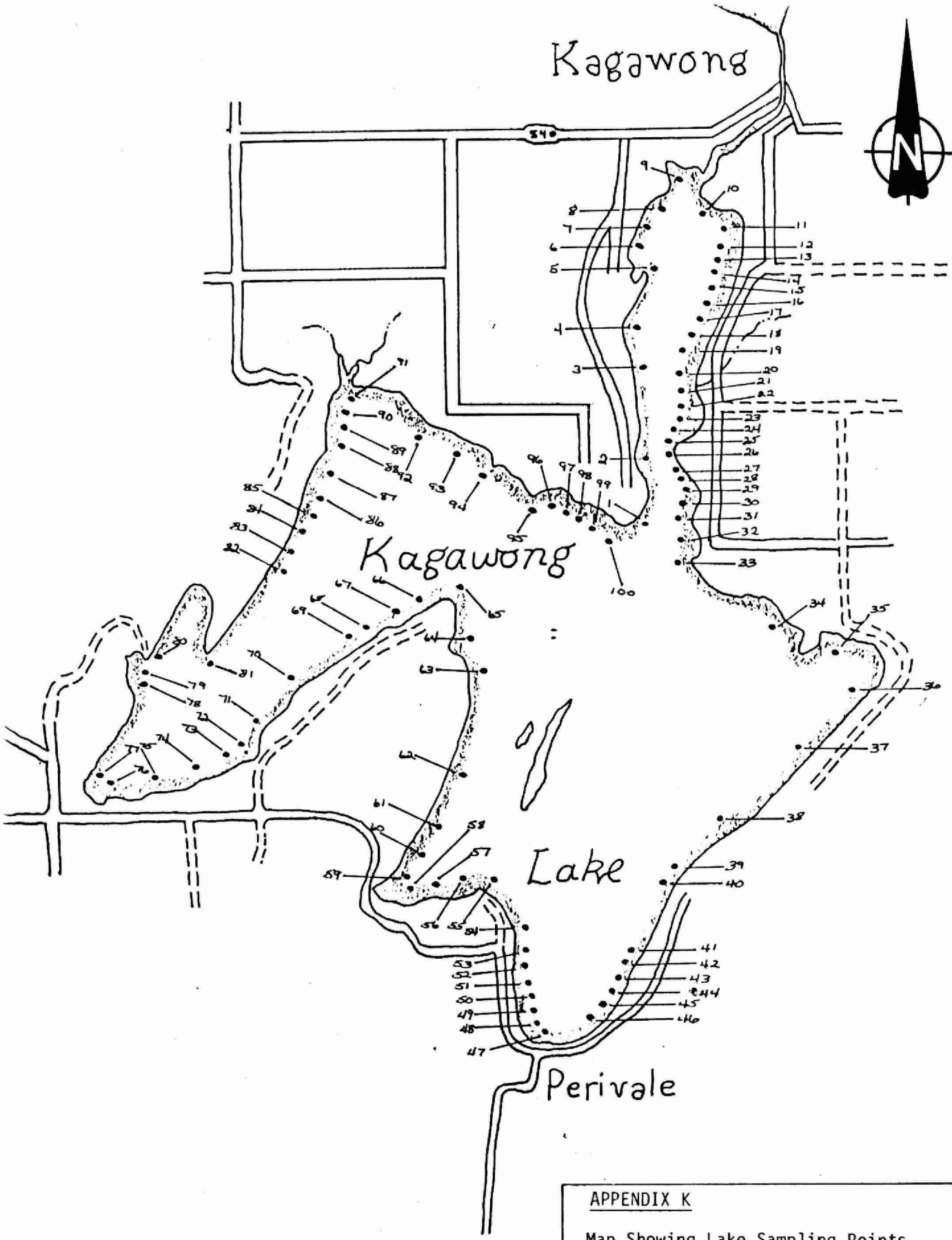
DRINKING WATER SOURCE

	NUMBER	% OF TOTAL
Well - Dug	8	4
- Drilled	40	20
Lake	109	55
Spring	2	1
Hauled	21	10
Unknown	20	10

TABLE II

DRINKING WATER TREATMENT

	NUMBER	% OF TOTAL
Boiled	16	8
Filtered	16	8
Chlorine	10	5
Other	3	2
None	105	52
Unknown	50	25



APPENDIX K

Map Showing Lake Sampling Points

APPENDIX L

GEOMETRIC MEANS FOR LAKE SAMPLE LOCATIONS

Sample Location	Total Coliform	Fecal Coliform
1	4.865	2.208
2	6.317	2.737
3	6.375	2.885
4	6.613	2.641
5	5.475	2.000
6	12.218	3.337
7	9.574	4.068
8	8.017	3.963
9	6.164	3.572
10	21.563	6.559
11	25.268	6.445
12	9.608	4.239
13	10.406	3.068
14	5.57	2.0
15	5.835	3.022
16	9.393	2.852
17	5.241	2.000
18	8.103	3.022
19	6.781	2.340
20	6.399	2.737
21	5.480	3.149
22	6.360	3.575
23	8.528	2.852
24	10.319	2.641
25	9.336	3.068
26	13.922	4.416
27	8.830	2.779
28	7.200	4.579
29	10.321	5.611
30	12.094	4.637
31	11.324	3.554
32	3.554	2.208
33	6.488	3.337
34	5.212	3.219
35	4.473	2.000
36	5.931	3.623
37	5.499	2.208
38	4.275	2.000
39	4.478	3.251
40	4.591	2.615
41	9.590	2.696
42	16.710	5.842
43	25.670	6.114
44	4.442	2.208
45	16.331	3.654
46	7.400	3.420
47	5.686	2.706
48	11.886	3.564
49	24.986	4.442
50	10.434	2.245

Sample Location	Total Coliform	Fecal Coliform
51	11.406	2.615
52	28.867	7.844
53	11.100	5.707
54	6.721	2.696
55	13.810	4.761
56	13.888	4.670
57	17.815	6.290
58	10.483	6.003
59	9.009	3.141
60	13.196	2.634
61	8.281	3.026
62	4.010	2.615
63	5.334	2.615
64	9.928	2.245
65	7.665	3.175
66	44.328	8.214
67	6.376	2.402
68	11.444	2.000
69	8.246	2.000
70	10.954	2.779
71	7.192	2.402
72	5.943	2.696
73	8.380	3.758
74	10.947	2.000
75	7.352	2.208
76	10.493	3.590
77	14.250	6.345
78	4.134	1.197
79	10.485	4.391
80	8.086	3.482
81	13.216	5.404
82	21.142	4.183
83	12.050	3.288
84	28.187	5.650
85	26.759	5.860
86	25.119	6.347
87	18.410	3.776
88	9.389	2.759
89	10.925	5.908
90	13.519	6.424
91	10.417	4.678
92	4.282	2.952
93	6.561	2.759
94	2.639	2.000
95	4.595	3.289
96	3.744	3.565
97	11.793	5.358
98	5.955	3.776
99	5.063	3.178
100	6.073	2.000

Figure 1
Relative Frequency of Geometric Mean Values
for Lake Sample Points for Total Coliform
Organisms

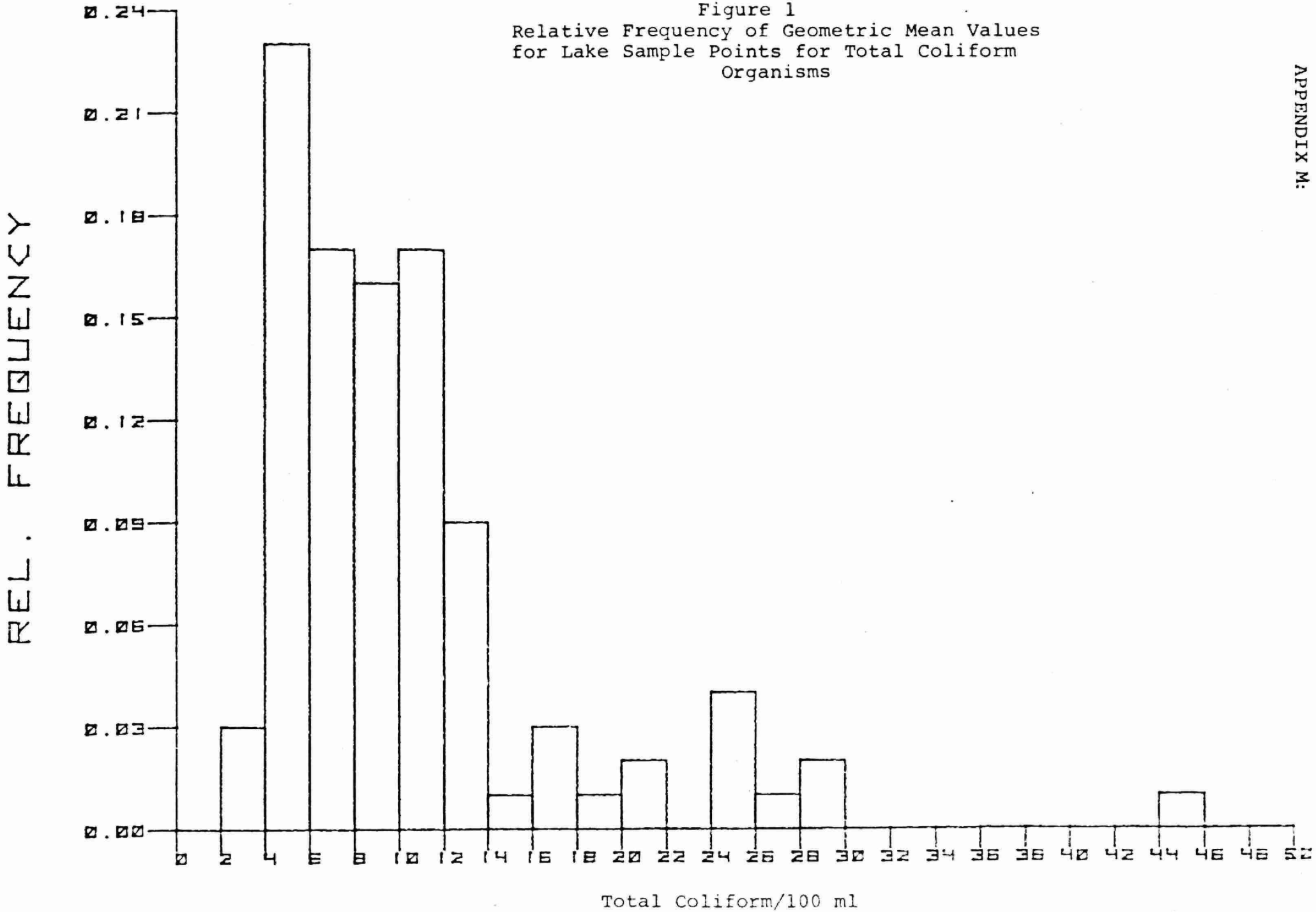
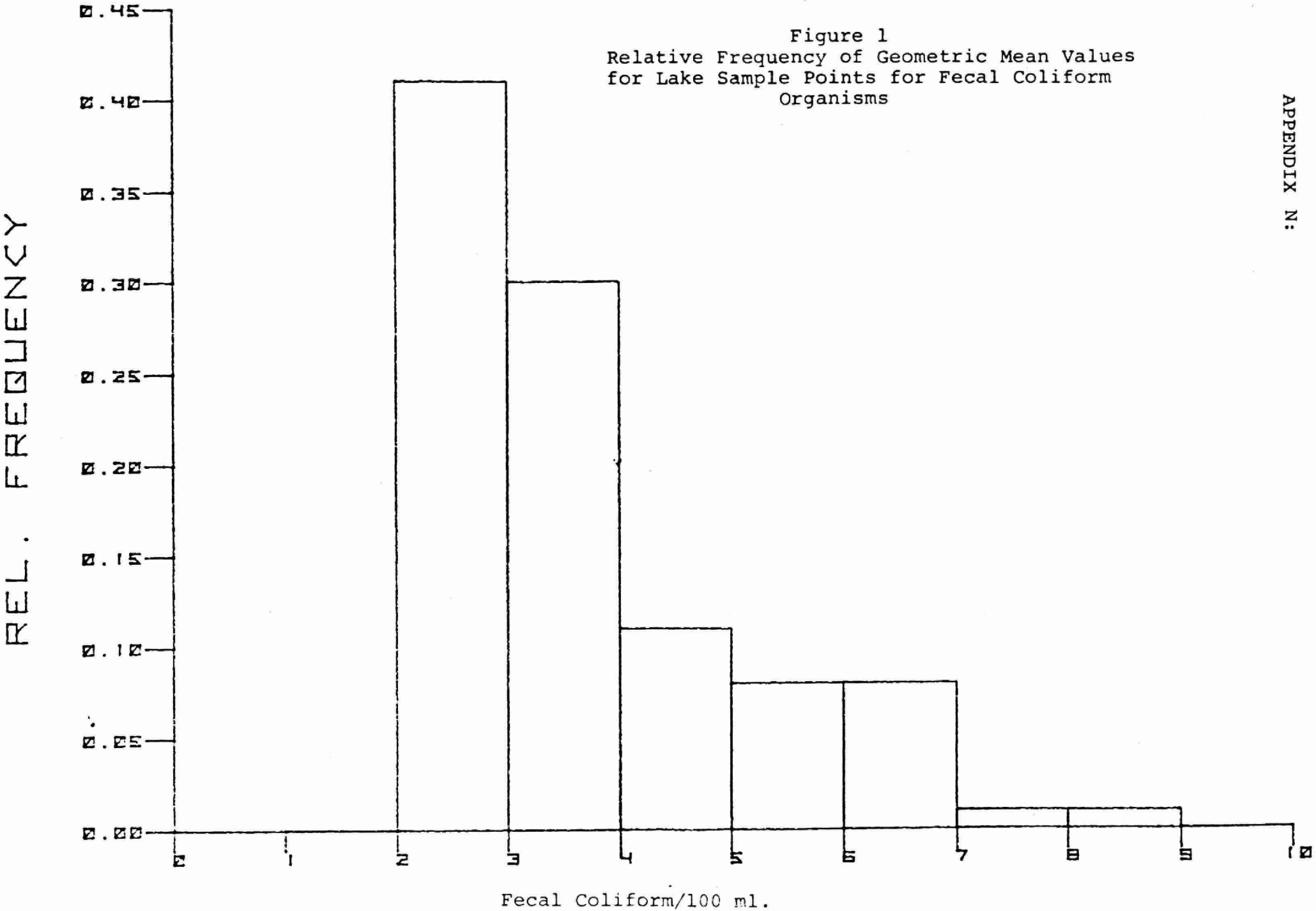


Figure 1
Relative Frequency of Geometric Mean Values for Lake Sample Points for Fecal Coliform Organisms



GLOSSARY

A. BACTERIOLOGICAL EXAMINATIONS

1. Coliform Bacteria

The direct search for a specific pathogen in water is too uneconomical and slow for routine control purposes. Instead water is examined for an indication of fecal contamination by using specific groups of bacteria as indicators. When these groups are found in the water it is assumed that the water is potentially harmful. The standard group of micro-organisms used as an indicator is the coliform group which includes all aerobic and facultative anaerobic, Gram-negative, nonspore forming, rod-shoped bacteria that ferment lactose with gas formation within 48 hours at 35°C. Organisms of the Escherchia coli strains which are usually of fecal origin, and of the intermediate and Aerobacter aerogenes strains which are usually but not always of soil, vegetable, or other non-fecal origin are included in this group.

1 (a) Total Coliforms

This group comprises species that are commonly associated with fecal matter (human and animal) and normal inhabitants of soil and vegetation. The presence of total coliforms in water may indicate contamination from soil runoff, or, less recent fecal pollution.

1 (b) Fecal Coliforms

These bacteria are mainly species associated with human and animal fecal matter. The presence of fecal coliforms in water indicates a relatively recent and near pollution input.

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